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[Continued on next page]

(54) Title: SURFACE MODIFICATION

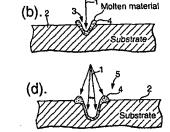
(or laser) beam (a). (e) Circular secondary m deflection shown thus: 🔿 Pattern

Electron

1000

repetitions

required at



(f). - Line Other secondary beam reflection patterns (examples)

Centre spot + circle C Ellipse ⚠ Triangle Square **Star** Star





(57) Abstract: A method of operating on a workpiece comprises causing relative movement between the workpiece and a power beam in a traverse direction so as to expose a series of locations on the workpiece to the power beam. At each location the power beam is caused to move relative to the workpiece in a predetermined manner having a component transverse to the traverse direction, and workpiece material is melted and displaced by the power beam so as to form a cavity or hole.



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A. CLASSIFICATION OF SUBJECT MATTER IPC 7 B23K15/08 B23K B23K26/08 B23K26/38 According to International Patent Classification (IPC) or to both national classification and IPC B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 B23K Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, PAJ, WPI Data C. DOCUMENTS CONSIDERED TO BE RELEVANT Relevant to claim No. Citation of document, with indication, where appropriate, of the relevant passages EP 0 577 833 A (NIPPON STEEL CORP) 1-3,5, 11-24, 12 January 1994 (1994-01-12) 28-41 Υ column 3, line 22 -column 5, line 13 4,6-10,25-27, 42-46 abstract; figures US 3 632 398 A (KONIG DIETER) Y 4 January 1972 (1972-01-04) 1-3,5-46 column 1, line 71 -column 2, line 14 A US 5 593 606 A (OWEN MARK D ET AL) 6,7 14 January 1997 (1997-01-14) 1-5,8-46 A column 5, line 43 -column 6, line 11 Patent family members are listed in annex. Further documents are listed in the continuation of box C. Special categories of cited documents: "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the *A* document defining the general state of the art which is not considered to be of particular relevance invention "E" earlier document but published on or after the international "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) involve an inventive step when the document is taken alone document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled "O" document referring to an oral disclosure, use, exhibition or other means document published prior to the international filing date but later than the priority date claimed "&" document member of the same patent family Date of the actual completion of the international search Date of mailing of the international search report 07/11/2002 31 October 2002 Name and mailing address of the ISA Authorized officer European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016

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0.40====	ALL DOCUMENTS CONSTRUCTION	PCT/GB 02/02237		
C.(Continu	ation) DOCUMENTS CONSIDERED TO BE RELEVANT Citation of document, with indication, where appropriate, of the relevant passages			
Odlegory	Oracion of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
Υ	PATENT ABSTRACTS OF JAPAN vol. 008, no. 100 (M-295), 11 May 1984 (1984-05-11) & JP 59 013588 A (TOKYO SHIBAURA DENKI KK), 24 January 1984 (1984-01-24) abstract	8,25-27		
Υ	EP 0 626 228 A (WELDING INST) 30 November 1994 (1994-11-30) cited in the application the whole document	9,10, 42-46		
X A	US 4 806 731 A (BRAGARD ADOLPHE ET AL) 21 February 1989 (1989-02-21) abstract; figures	1-3,5, 9-24 25-46		
X A	GB 2 069 906 A (SUMITOMO METAL IND) 3 September 1981 (1981-09-03) page 1, line 4 - line 7 page 1, line 42 - line 47	1-3,5,6, 9 7,8, 10-46		
x	page 2, line 47 - line 93 abstract; figures US 5 609 779 A (CROW JOHN M ET AL) 11 March 1997 (1997-03-11)	1-3		
A	column 2, line 50 -column 3, line 17 abstract; figures	4-46		
X A	US 5 225 650 A (SUTOR ULI DIPL PHYS ET AL) 6 July 1993 (1993-07-06) column 2, line 40 -column 4, line 37 column 5, line 36 -column 6, line 10 abstract; figures	1-3 4-46		
(PATENT ABSTRACTS OF JAPAN vol. 012, no. 416 (M-759), 4 November 1988 (1988-11-04) -& JP 63 154279 A (MITSUBISHI ELECTRIC CORP), 27 June 1988 (1988-06-27)	1-3		
4	abstract	4–46		
(US 3 246 079 A (RUDOLF TEUCHER) 12 April 1966 (1966-04-12)	1-3		
1	column 4, line 22 - line 56 figures 5-8	4-46		
	US 5 324 912 A (BOPPEL WOLFGANG ET AL) 28 June 1994 (1994-06-28)	1-3		
	column 2, line 58 -column 3, line 4 column 6, line 11 - line 47 abstract; figures	25-34		
	(continuation of second sheet) (July 1992)			

nformation on patent family members

In tional Application No
PCT/GB 02/02237

				101745	02/0223/
Patent document dited in search report		Publication date		Patent family member(s)	Publication date
EP 0577833	A	12-01-1994	JP JP JP JP AU AU CA	2067959 C 4238654 A 7096147 B 4361854 A 646547 B2 1163692 A 2076747 A1	10-07-1996 26-08-1992 18-10-1995 15-12-1992 24-02-1994 17-08-1992 12-07-1992
			EP WO KR US	0577833 A1 9211960 A1 9605881 B1 5391856 A	12-01-1994 23-07-1992 03-05-1996 21-02-1995
US 3632398	A	04-01-1972	AT AT BE CH CH FR GB NL NL SE	287427 B 297171 B 716298 A 716334 A 503803 A 497242 A 1621355 A1 1587059 A 1587060 A 1217350 A 1225804 A 6808136 A 6808137 A 350420 B	25-01-1971 10-03-1972 09-12-1968 10-12-1968 28-02-1971 15-10-1970 13-05-1971 13-03-1970 13-03-1970 31-12-1970 24-03-1971 10-12-1968 10-12-1968 30-10-1972
US 5593606	A	14-01-1997	CH DE EP JP KR WO US	691672 A5 19581694 T0 0771243 A1 10508798 T 258287 B1 9602351 A1 5614114 A 5841099 A	14-09-2001 21-08-1997 07-05-1997 02-09-1998 01-06-2000 01-02-1996 25-03-1997 24-11-1998
JP 59013588	Α	24-01-1984	NONE		
EP 0626228	Α	30-11-1994	EP JP	0626228 A1 7148584 A	30-11-1994 13-06-1995
US 4806731	A	21-02-1989	BE BE BE BE LU AT DE DE JP JP	1000570 A7 1000692 A6 1001397 A6 1001339 A6 1001341 A6 86784 A1 90890 T 3881906 D1 3881906 T2 0280671 A2 1022406 A 2030363 C 7067566 B	07-02-1989 14-03-1989 24-10-1989 03-10-1989 03-10-1989 20-09-1988 15-07-1993 29-07-1993 20-01-1994 31-08-1988 25-01-1989 19-03-1996 26-07-1995
GB 2069906	Α	03-09-1981	JP JP DE	56119681 A 56119687 A 3100927 A1	19-09-1981 19-09-1981 17-12-1981

nformation on patent family members

in itional Application No PCT/GB 02/02237

						1017 45	ol, ollo,
	atent document d in search report		Publication date		Patent family member(s)		Publication date
GB	2069906	Α		FR	2476524	A1	28-08-1981
US	5609779	A	11-03-1997	DE	69708744	D1	17-01-2002
				DE	69708744	T2	29-08-2002
				ΕP	0807485		19-11-1997
				JP	10085977	A	07-04-1998
US	5225650	- А	06-07-1993	DE	3923356		07-02-1991
				DE	8911733		16-11-1989
				CN	. 1048996		06-02-1991
				DE	59002985		11-11-1993
				EP	0407969		16-01-1991
				ES	2054166		01-08-1994
				JP	2787990		20-08-1998
				JP	3114688		15-05-1991
				RU	2085351		27-07-1997
				RU	2086378		10-08-1997
				US	5149937 	A 	22-09-1992
JP	63154279	Α	27-06-1988	JP	2581684	B2	12-02-1997
US	3246079	Α	12-04-1966	DE	1123561		
				FI	40970		31-03-1969
				FR	1301509		17-08-1962
	·			NL	268860	Α	
US	5324912	Α	28-06-1994	DE	4031546	 A1	09-04-1992
				ΑU	8620191		28-04-1992
				WO	9205910		16-04-1992
				DE	59104094		09-02-1995
				EP	0551316	A1	21-07-1993
				JP	2600040	B2	16-04-1997